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EXAMINER
MUTSCHLER, BRIAN L

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1753	

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4

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/760,884	Applicant(s) ANDRICACOS ET AL.	
	Examiner Brian L. Mutschler	Art Unit 1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 February 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31* is/are pending in the application.

4a) Of the above claim(s) *1-9 and 24-28* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *10-23 and 29-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Comments

1. The objection to claim 10 has been overcome by Applicant's amendment.

2. In light of Applicant's response and upon further reconsideration, the rejection of claims 10 and 13-20 under 35 U.S.C. 102(b) over GILTON et al. has been withdrawn. While disclosing a current density of 1.0 mA/cm^2 or less, which includes the claimed current density range, the range is sufficiently different to preclude a rejection based on anticipation. New rejections of the claims have been set forth below using a teaching reference that teaches the benefits of the various current density ranges. Similar revisions have been made to the rejections of claims 11, 12 and 21-23.

3. In light of Applicant's response and upon further consideration, the rejection of claims 10-23 under the judicially created doctrine of obviousness-type double patenting over U.S. Pat. No. 6,416,812 has been withdrawn. US '812 discloses a similar plating bath, but does not teach or suggest the use of such a bath in an electroplating step.

Specification

4. The disclosure is objected to because of the following informalities:

   a. On page 2 at lines 8-9, the reference "(Hu et al., Mat.Chem. Phys., 52 1998)5)" should be corrected for grammar and punctuation;

   b. On page 3 under the heading "BRIEF DESCRIPTION OF THE FIGURES", a brief description of Figure 3 should be added;

c. On page 4 at line 14, the reference character **5** should be deleted or indicated as --(not shown)-- because it is not included in the figures;

d. On page 4 at line16, "both" should be changed to --bath--;

e. On page 5 at line 2, please change "20μA/cm" to --20 $\mu A/cm^2$--;

f. On page 5 at line 4, the units of the range "0.02 to about 0.511" should be identified, e.g., add --M-- for molar;

g. On page 5 at lines 4-5, the punctuation in the phrase "Na_2EDTA(sodium salt of ethylene diamine tetraacetic acid." should be corrected; and

h. On page 6 at line 7, please change "Na2EDTA" to --Na_2EDTA--.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 10-23 and 29-31 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Claim 10 recites the limitation "a current density of about 5 to about 25 $\mu A/cm^2$". In the instant disclosure on page 5 at lines 1-2, it states, "The electroplating is carried out employing a current density of about 5 to about 25 $\mu A/cm^2$ and preferably about 10

to about 20μA/cm[^{2}]." However, the other ranges cited in the disclosure and in the examples recite different units. On page 3 at lines 5-6, it states, "a deposition rate of at least 15mA/cm^2"; on page 4 at lines 27-28, it states, a deposition rate of about 5 to about 20 mA/cm^2"; in Example 1 on page 5 at line 21, it states, "a constant current of about 20 mA/cm^2"; in Example 2 on page 6 at line 2, it states, "the current density about 15 mA/cm^2"; and in Example 3 on page 6 at line 21, is states, "the current density about 20 mA/cm^2". Since the examples only disclose enablement for the deposition rates/current densities in the range from 5 to 25 mA/cm^2, the disclosure does not appear to demonstrate enablement for the range from 5 to 25 μA/cm^2 as claimed, a difference of three orders of magnitude.

As explained in more detail below, rejections have been made based on both current density ranges.

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. Claims 17, 23, 30 and 31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 17 recites the limitation "the recess has" in line 1. There is insufficient antecedent basis for this limitation in the claim. Claim 10, from which claim 17 depends, recites "recesses" in line 2. The phrase should be changed from "the recess has" to --the recesses have--.

Claim 23 recites the limitation "the plating bath" in line 1. There is insufficient antecedent basis for this limitation in the claim. The phrase should be changed to --the electroplating bath--.

Claim 30 and claim 31 each recite the limitation "wherein the depositing of copper is carried out at a rate of about 5 to about 25 $\mu A/cm^2$". This limitation is indefinite because it is not clear how the rate of deposition, using the units disclosed, differs from the current density. While the unit ampere, A, is a measure of charge per second, C/s, and could be considered a rate of charge, the use of these units to define the rate of deposition is not clear. Deposition rates are usually described in terms of thickness per unit time. Since the units are identical to the claimed current density, the limitations regarding the rate of deposition are either contradictory or do not further limit the claims from which they depend. Claim 30 depends from claim 29, which recites a narrower range than claim 30. This limitation is indefinite because a narrow range cannot be further limited by a broader range. Claim 31 recites the same range as the range recited in claim 10, which does not further limit claim 10.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 10-14, 16, 18-20 and 29-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over GILTON et al. (U.S. Pat. No. 5,151,168) in view of WOO et al. (U.S. Pat. No. 6,440,289).

Regarding claim 10, GILTON et al. disclose a method for fabricating an electronic structure that comprises forming an insulating material **11** on a substrate **12** (fig. 1; col. 4, line 46 to col. 5, line 9). Lines and/or vias **13**, having sidewalls and bottom surfaces, are lithographically defined and formed in the insulating material **11** (fig. 1; col. 4, lines 46-52). A barrier layer **21** is formed on the insulating layer **11** (fig. 2; col. 4, lines 53-65). An additional insulating layer **31**, comprised of silicon dioxide, is formed and the lines **13** are further defined and formed in the insulating layer **31** (fig. 3; col. 5, lines 2-9). Copper **41** is formed on the barrier layer **21** be electroplating using a bath having a pH of 6.5 to 14.0, with a preferred pH of 13.5 (fig. 4; col. 5, lines 10-35 and col. 7, lines 1-6). The bath further comprises a source of cupric ions and a complexing agent (col. 5, lines 10-35).

Regarding claim 13, for the barrier layer **21**, GILTON et al. teach the use of materials such as "titanium nitride, titanium-tungsten, or nitrided titanium-tungsten" (col. 2, lines 52-56).

Regarding claim 14, GILTON et al. disclose that the barrier layer **21** has an optimum layer of 200 Å to 300 Å (20 nm to 30 nm), which is greater than 4 nm (col. 3, lines 44-45).

Regarding claim 16, GILTON et al. disclose the use of silicon dioxide as an insulating layer (col. 5, lines 2-5).

Regarding claim 18, GILTON et al. teach the use of a bath temperature within a range of 20°C to 35°C (col. 7, lines 7-9).

Regarding claim 19, the source of cupric ions is $CuSO_4$ and the complexing agent is EDTA (col. 5, lines 10-21).

Regarding claim 20, sodium hydroxide or potassium hydroxide is used to adjust the pH (col. 5, lines 28-29).

The method disclosed by GILTON et al. differs from the instant invention because GILTON et al. do not disclose the following:

a. A current density of about 5 to about 25 $\mu A/cm^2$, as recited in claim 10;

b. The copper is deposited to provide a thickness of about 10 nm to about 100 nm, as recited in claim 11;

c. The copper is deposited to provide a thickness of about 20 nm to about 50 nm, as recited in claim 12;

d. The current density is about 10 to about 20 $\mu A/cm^2$, as recited in claim 29; and

e. The depositing of the copper is carried out at a rate of about 5 to about 25 $\mu A/cm^2$, as recited in claims 30 and 31.

Regarding claims 10 and 29-31, WOO et al. disclose a method for forming electronic structures comprising the step of forming oxide layers **110** and **116** to define lines and vias, followed by the formation of a barrier layer **124** and the electroplating of copper **126** (fig. 2; col. 4, lines 6-60). The copper **126** is deposited at different current densities to avoid the formation of voids in the vias (col. 5, lines 3-18). WOO et al.

teach that low current densities should be used when beginning the plating because they plate evenly (col. 5, line 3 to col. 6, lines 4). Very low current densities are used because they plate more uniformly than higher current densities.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used a very low current density in the method of GILTON et al. as taught by WOO et al. because very low current densities plate more uniformly than higher current densities and help avoid the formation of voids in the vias.

Regarding claims 11 and 12, WOO et al. disclose that the very low current densities are used to plate copper to a thickness of "a few hundred (100 to 300) angstroms", followed by additional plating at higher current densities (col. 3, lines 23-33).

Furthermore, the amount of copper that is plated is proportional to how long the method is applied with the current density that is used. As such, the thickness of the deposited layer is a variable controlled by the user. It is the overall method steps that are given patentable weight and not the structural limitations thereof unless the structural limitations materially alter the overall method (*In re Leesona Corp.*, 185 USPQ 156; *Ex parte Pfeiffer*, 1962 CD 408; *Ex parte Kangas*, 125 USPQ 419; *Ex parte Foreman*, 1924 CD 47; *Ex parte Nelson et al*, 82 USPQ 115; *In re Winder*, 1957 CD 175; *Ex parte Hart*, 117 USPQ 193). It does not appear that the overall method of GILTON et al. is significantly altered as a function of the thickness of the electrodeposited layer. The GILTON et al. method and the method of the instant

invention are both processes for forming high aspect ratio damascene structures. As such, the thickness of the thus formed structure appears to be a matter of designer choice and optimization given the art known and technology definitions of size parameters of "high-aspect" microstructures. The electrolytic deposition of filling the recess is allowed to occur until a sufficient thickness is deposited.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the method of GILTON et al. to deposit copper to a desired thickness such as 10 nm to 30 nm or more, as taught by WOO et al.

11. Claims 10-14, 16-20 and 29-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 99/47731, herein referred to as WO '731, in view of LANDAU (U.S. Pat. No. 6,261,433). (Please note: The following rejection is based on a current density of 5 to 25 mA/cm^2.)

Regarding claim 10, WO '731 discloses a method for fabricating electronic structures wherein a barrier layer **10** is formed over an insulating layer **8** having trenches **5** or vias (lines of metallization) formed therein (fig. 2A; page 12 to page 13). Copper is electroplated directly onto the barrier layer **10** (page 12). The electroplating bath is comprised of copper sulfate, as a source of cupric ions, and a complexing agent (page 16). The bath is maintained at a pH of at least 9.0 and can have a pH of 5-13 (page 17). The current density used for electroplating "can be 1 to 5 $milliamps/cm^2$", which contains the endpoint of the claimed range (page 18).

Regarding claim 13, the barrier layer **10** can be made of titanium nitride or tantalum nitride (page 12).

Regarding claim 14, the thickness of the barrier layer is approximately 100 to 300 Angstroms (10 to 30 nm), which is greater than 4 nm (page 13).

Regarding claim 16, the dielectric **8** is silicon dioxide (page 13).

Regarding claim 18, the temperature of the electroplating bath can be within a range of 20 to 35°C (page 18).

Regarding claim 19, copper sulfate is used as the source of cupric ions and EDTA is used as a complexing agent (page 17).

Regarding claim 20, potassium hydroxide or sodium hydroxide may be used to control the pH (page 17).

The method disclosed by WO '731 differs from the instant invention because WO '731 does not disclose the following:

a. Lithographically defining and forming recesses for lines and/or vias, as recited in claim 10;

b. A current density of greater than 5 mA/cm^2 to 25 mA/cm^2, as recited in claim 10;

c. Copper deposited to provide a thickness of about 10 nm to about 100 nm, as recited in claim 11;

d. Copper deposited to provide a thickness of about 20 nm to about 50 nm, as recited in claim 12;

e. The recesses have an aspect ratio of greater than 3:1, as recited in claim 17;

f. The current density is about 10 to about 20 mA/cm^2, as recited in claim 29; and

g. The depositing of the copper is carried out at a rate of about 5 to about 25 mA/cm^2, as recited in claims 30 and 31.

Regarding claims 10 and 29-31, WO '731 discloses that the current density can be "1 to 5 milliamps/cm^2 (page 18). LANDAU discloses a method for fabricating electronic structures comprising the step of forming an insulating layer **16** and forming recesses defining vias using a lithographic technique (fig. 1A-1E; col. 2, lines 34-57). A barrier layer **20** is formed on the insulating layer **16** and copper **22** is electroplated on top of the barrier layer **20** (col. 2, line 58 to col. 3, line 26). LANDAU teaches "plating/deposition is accomplished with a relatively low current density for a relatively long interval because low current density promotes deposition uniformity" (col. 15, lines 48-63). LANDAU discloses the use of current densities of about 5 mA/cm^2 to about 40 mA/cm^2 (col. 16, lines 21-24). The current density is chosen to provide the desired uniformity.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used lithographic technique for forming the recesses in the insulating layer of WO '731 as taught by LANDAU because lithographic techniques efficiently and accurately form patterns in insulating layers.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the current density in the method of WO '731 to use a current density of about 5 mA/cm^2 to about 25 mA/cm^2 because LANDAU teaches that the uniformity of the deposited copper can be controlled by the current density and that low current densities promote greater uniformity.

Regarding claims 11 and 12, the amount of copper that is plated is proportional to how long the method is applied with the current density that is used. As such, the thickness of the deposited layer is a variable controlled by the user. It is the overall method steps that are given patentable weight and not the structural limitations thereof unless the structural limitations materially alter the overall method (*In re Leesona Corp.*, 185 USPQ 156; *Ex parte Pfeiffer*, 1962 CD 408; *Ex parte Kangas*, 125 USPQ 419; *Ex parte Foreman*, 1924 CD 47; *Ex parte Nelson et al*, 82 USPQ 115; *In re Winder*, 1957 CD 175; *Ex parte Hart*, 117 USPQ 193). It does not appear that the overall method of WO '731 is significantly altered as a function of the thickness of the electrodeposited layer. The method disclosed by WO '731 and the method of the instant invention are both processes for forming high aspect ratio damascene structures. As such, the thickness of the thus formed structure appears to be a matter of designer choice and optimization given the art known and technology definitions of size parameters of "high-aspect" microstructures. The electrolytic deposition of filling the recess is allowed to occur until a sufficient thickness is deposited.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the method of WO '731 to deposit copper to a desired thickness such as 10 nm to 30 nm or more, as taught by WOO et al.

Regarding claim 17, the method of WO '731 is used to fill vias and trenches **5** with copper. However, the aspect ratios of the microstructures are not disclosed. LANDAU teaches that the method of electroplating copper in vias can be used for filling structures having aspect ratios exceeding 4:1 (col. 1, lines 34-39).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the method of WO '731 to fill vias having aspect ratios exceeding 3:1 because LANDAU teaches that the plating method can be used to plate vias having aspect ratios exceeding 4:1.

12. Claims 15 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over GILTON et al. (U.S. Pat. No. 5,151,168) in view of WOO et al. (U.S. Pat. No. 6,440,289), as applied above to claims 10-14, 16, 18-20 and 29-31, and further in view of TING et al. (U.S. Pat. No. 5,969,422).

GILTON et al. and WOO et al. describe a method having the limitations recited in claims 10-14, 16, 18-20 and 29-31 of the instant application, as explained above in section 10.

The method described by GILTON et al. and WOO et al. differs from the instant invention because they do not disclose the following:

a. The barrier layer is tungsten, as recited in claim 15;

b. The electroplating bath further comprises a stabilizer and surfactant, as recited in claim 21;

c. The stabilizer is 2,2'-bipyridyl, as recited in claim 22; and

d. The electroplating bath further comprises cyanide ions, as recited in claim 23.

Regarding claim 15, TING et al. disclose a method for forming copper interconnect structures in electronic devices by plating copper over a barrier layer **30**, which is formed on an insulating layer **11** (fig. 3; col. 9, lines 52-65). The barrier layer **30** can be made of a material including tantalum, titanium, tungsten, tungsten nitride or other materials (col. 7, lines 29-31).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the barrier layer metal in the method of GILTON et al. and WOO et al. to use tungsten as taught by TING et al. because tungsten is an equivalent barrier metal to other titanium/tungsten materials disclosed by GILTON et al. and WOO et al. and would be expected function equivalently.

Regarding claims 21-23, TING et al. discloses the use of an electroplating bath comprising copper sulfate, EDTA, potassium hydroxide, "RHODAFAC RE 610 or polyethylene glycol as a surfactant and wetting agent, and ammonium cyanide or 2,2'-dipyridyl as a stabilizer" (col. 10, lines 42-55).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroplating bath in the method of GILTON et al. and WOO et al. to use surfactants and stabilizers as taught by TING et al. because TING et al. have shown that the use of a stabilizer and surfactant in the electroplating bath would have promoted ductility and prevented the formation of nodules in the electroplated copper deposit, thus significantly advancing void-less fill of the via structure.

13. Claims 15 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 99/47731 in view of LANDAU (U.S. Pat. No. 6,261,433), as applied above to claims 10-14, 16-20 and 29-31, and further in view of TING et al. (U.S. Pat. No. 5,969,422). (Please note: The following rejection is based on a current density of 5 to 25 mA/cm^2.)

WO '731 and LANDAU describe a method having the limitations recited in claims 10-14, 16-20 and 29-31 of the instant invention, as explained above in section 11.

The method described by WO '731 and LANDAU differs from the instant invention because they do not disclose the following:

a. The barrier layer is tungsten, as recited in claim 15;

b. The electroplating bath further comprises a stabilizer and a surfactant, as recited in claim 21;

c. The stabilizer is 2,2'-bipyridyl, as recited in claim 22; and

d. The electroplating bath further comprises cyanide ions, as recited in claim 23.

Regarding claim 15, TING et al. disclose a method for forming copper interconnect structures in electronic devices by plating copper over a barrier layer **30**, which is formed on an insulating layer **11** (fig. 3; col. 9, lines 52-65). The barrier layer **30** can be made of a material including tantalum, titanium, tungsten, tungsten nitride or other materials (col. 7, lines 29-31).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the barrier layer metal in the method of WO '731 and LANDAU to use tungsten as taught by TING et al. because tungsten is an equivalent barrier metal to other tantalum/titanium/tungsten/nitride materials disclosed by WO '731 and LANDAU and would be expected function equivalently.

Regarding claims 21-23, TING et al. discloses the use of an electroplating bath comprising copper sulfate, EDTA, potassium hydroxide, "RHODAFAC RE 610 or polyethylene glycol as a surfactant and wetting agent, and ammonium cyanide or 2,2'-dipyridyl as a stabilizer" (col. 10, lines 42-55).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electroplating bath in the method of WO '731 and LANDAU to use surfactants and stabilizers as taught by TING et al. because TING et al. have shown that the use of a stabilizer and surfactant in the electroplating bath would have promoted ductility and prevented the formation of nodules in the

electroplated copper deposit, thus significantly advancing void-less fill of the via structure.

14. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over GILTON et al. (U.S. Pat. No. 5,151,168) in view of WOO et al. (U.S. Pat. No. 6,440,289), as applied above to claims 10-14, 16, 18-20 and 29-31, and further in view of LANDAU (U.S. Pat. No. 6,261,433).

GILTON et al. and WOO et al. describe a method having the limitations recited in claims 10-14, 16, 18-20 and 29-31 of the instant application, as explained above in section 10. GILTON et al. further disclose, "the plating process will automatically fill contact/via openings to a uniform thickness which is independent of the depth of contact/via openings **13**" (col. 5, lines 32-35).

The method described by GILTON et al. and WOO et al. differs from the instant invention because they do not disclose the recesses having an aspect ratio of greater than 3:1.

LANDAU teaches that the method of electroplating copper in vias is used for filling structures having aspect ratios exceeding 4:1 (col. 1, lines 34-39).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have used the method of GILTON et al. and WOO et al. to fill vias having aspect ratios exceeding 3:1 because LANDAU teaches that the plating method is used to plate vias having aspect ratios exceeding 4:1.

Response to Arguments

15. Applicant's arguments with respect to claims 10-23 have been considered but are moot in view of the new ground(s) of rejection.

16. Applicant argued the rejection of the claims based on the fact that the claimed range, although contained within the prior art of GILTON et al., was not explicitly disclosed in such a way as to anticipate the claimed range. The rejection was withdrawn and a new rejection was made incorporating a teaching reference that teaches the benefits of using different current densities, particularly with regard to the use of very low current densities to form uniform layers.

Conclusion

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

blm
March 21, 2003

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700